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Identifying the missing link between climate change policies and sectoral/regional planning supported by Strategic Environmental Assessment in emergent economies: Lessons from Brazil

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ABSTRACT

A number of public policies have emerged worldwide as a response from governments facing climate change effects, drawing the attention of the scientific community to the outcomes and actual effects/benefits these policies have brought so far. One of the challenging aspects related to this context is the integration of the objectives set by climate change policies within the sectoral and regional planning. In this respect, the literature recognizes the relevance of Strategic Environmental Assessment (SEA) as an instrument to deal with climate change issues in the planning process and to support the development of alternatives to respond to climate change policies. The influence of climate change policies on the plans and programs supported by SEA in emerging economies is yet to be verified. The paper relies on the case of Brazil, recognized by its relevance in terms of biodiversity, water resources and climate regulation. In 2009, Brazil introduced the National Policy of Climate Change (NPCC), which established guidelines to reduce the emissions of greenhouse gases (GHG) by 2020. The present paper is based on the analysis of the current SEA practice and the corresponding level of integration of climate change issues, considering the objectives of the NPCC. A set of 29 statements, delivered by the literature, was applied, combined to the content analysis techniques to review the quality of 35 SEA reports produced in Brazil between 1997 and 2014 (out of 40-odd cases). The outcomes indicate the performance is similar to what was found in other contexts, i.e., SEA areas barely address climate change issues. This thus reveals an important gap between the objectives of NPCC and sectoral/regional planning. SEA can contribute to reducing this gap, but it needs more strength to influence the development of sectoral and regional policies and plans.

1. Introduction

Climate change has been recognized as a priority in the global environmental agenda. According to the latest (fifth) assessment report, published by the Intergovernmental Panel on Climate Change (IPCC) in 2013, there is a reasonable scientific correlation between climate changes, human activities, and significant impacts on the environment and society, which must be urgently addressed by governments [1].

As a response to the awareness of the global society, a number of policies have emerged worldwide focusing on the challenges of climate change. The IPCC Summit, in 2015, resulted in an international commitment to implement effective strategies to mitigate the causes of climate change and to adapt to a different scenario. For the first time, voluntary goals to be accomplished by emerging economies to reduce global emissions of greenhouse gases (GHG) were included. In Brazil, the world's sixth largest issuer (2.9% of the global emissions), GHG emissions are expected to continue increasing in different sectors, reflecting the recent period of economic growth. After a period

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(2009–2012) of significant reduction in emissions based on deforestation control, annual estimations showed an increase of 7.8% in 2013 as compared to the previous year; they decreased in 2014 and again increased in 2015, reaching 1.402 million Net CO_2eq shared by land use (46%), energy (24%), agriculture and cattle (22%), industry (5%) and residues (3%) [2].

Brazil has a key role in the global strategies of climate change due to its GHG emission profile, large experience with biofuels and a massive potential to export carbon credits (currently, Brazil is amongst the three main countries in number of Clean Development Mechanism projects) [3].

Although government commitments to reduce greenhouse gas emissions are made on a voluntary basis, there are a number of local initiatives to address climate change. In 2009, the Brazilian Federal government passed the National Policy on Climate Change (NPCC – Federal Law 12.187/2009 and Federal Decree 7390/2010), establishing a target 38.9% reduction in GHG emissions to be achieved by 2020 [4]. Moreover, sectoral plans defining actions, performance indicators and specific reduction targets, as well as adaptation strategies, have been developed as a response to this Federal legislation [5].

In this context, the mechanisms and opportunities to integrate the objectives defined by climate change policies in sectoral and regional plans and programs play an important role [6].

Strategic Environmental Assessment (SEA) is an instrument to promote sustainability in decision-making [7] and to stimulate opportunities for timely consideration of climate change issues [8]. In addition, there is a growing interest in the performance of both climate change policies and strategic assessment in different contexts [9,10] and, recently, there has been a stronger concern in developing and emerging countries [11].

Considering the influence of climate change policies on plans and programs supported by the SEA is yet to be verified, the present paper focuses on the integration of climate change issues in strategic decisions supported by the SEA. The analytic work supporting the research is based on the application of 29 statements from an applied framework [12] and on content analysis techniques to review the quality of climate change issues of 35 SEA reports prepared in Brazil, out of 40-odd cases identified from 1997 to 2015.

2. Background

Climate change is an issue encompassing scientific complexity, uncertainty and indeterminacy [13] and is one of the major challenges posed to contemporary society [6]. Its relevance is supported by global initiatives aimed at controlling human activities associated with climate change. In this context, the World Conference on the Changing Atmosphere, the establishment of the IPCC and the United Nations Framework Convention on Climate Change can be understood as major milestones of the governance framework on climate change. The IPCC reports are considered the main reference for climate change issues by presenting international scientific soundness [13] and by influencing decision-making by global governments; the fifth report (the latest at the time this paper was written), presented in 2013, reaffirmed the responsibility of human actions for global warming and the urgency of adopting strategies for mitigation and adaptation.

The need to reverse GHG emissions led to the Kyoto Protocol, a global agreement signed in 1997. It established a set of explicit reduction commitments by developed countries, as well as some program incentives for carbon sinks and for transferring clean technologies from developed countries to developing ones [14].

International negotiations to control human action to prevent the worsening of global climate change are re-arranged in terms of public policy, represented in the planning process established on the precautionary principle that aims at ensuring safeguards for the climate effects [15]. National government actions are key to tackle climate change and to undertake effective public policies for mitigation and adaptation [16,17].

As a signatory of the Kyoto Protocol since 1998, Brazil launched its first national climate change policy NPCC, in 2009, adopting voluntary targets for GHG emissions reduction by 38.9%, by 2020. This policy also helps to formalize the Brazilian position in the multilateral and international discussions to face the challenge of global warming, thus constituting the framework for mitigation and adaptation in the country [18]. Following the national policy, other Brazilian states introduced their own climate policies. Interestingly, considering the objectives of this paper, one of these state policies (in the State of São Paulo) has explicit provisions for applying SEA to assess climate change effects from sectoral development [19].

The SEA is considered an instrument for impact assessment that facilitates both the identification of opportunities and risks of strategic actions to sustainable development [20]. The SEA is largely applied worldwide at different planning levels: more than 60 countries have great expertise and practice in using this tool to support the development of policies, plans and programs [9]. However, the SEA is not mandatory for any type of plans and programs in Brazil and it is sparsely used in the country [21–23], hindering the accumulation of experience and thus decreasing the capacity to learn from its application [24,25].

The relationship between climate change and the SEA has a transversal nature within various forms of planning and requires the definition of a set of goals for reducing emissions and for proposing measures for spatial development and adaptation [10]. In this context, SEA allows integrating climate change issues into plans and programs in many sectors and provides a technical basis to ensure that the strategic action related to climate change can be supported by the systematic consideration of the environment [6].

The relevance of including climate change into the SEA practice is deemed to be contradictory considering the little attention given to this aspect, even in countries with a mandatory SEA [26]. Instead of being comprehensively embedded in the current SEA practice, climate change issues are limited to mitigation and little attention is given to assessing the synergies between adaptation and other environmental policies [6]. Nevertheless, attempts to better explore climate change adaptation in the SEA were previously carried out for different sectors, such as river basin management plans [8] and urban planning [27].

Forecasting scenarios on climate change in impact assessments is alson an attempt to reduce the uncertainties inherent to planning process and decision making [28]. To this respect, one research [29, p. 893] argues that “it is not sufficient to concentrate on either mitigation or adaptation, but a combination of these results in the most sustainable outcomes”.

A number of countries have already adopted guidance relating climate change and the SEA, including the USA, Canada, the UK and the Netherlands. The European Union has already included climate change in the revised Environmental Impact Assessment directive (2011) and is expected to advance to the strategic level after the revision of the SEA directive [30]. Also, Multilateral Development Agencies, such as the Organization for Economic Cooperation and Development (OECD) and the Inter-American Development Bank (IDB) have issued guidance to promote the integration of climate change into the SEA.

Still, there is no evidence in literature relating the issuance of guidance and the adequate integration of CC issues into the SEA. Nevertheless, the need for an explicit consideration of mitigation and adaptation in the SEA-supported planning has been emphasized [25]

3. Methods

The lack of an official repository of SEA planning initiatives [21,24], the absence of specific legal provision [22] and also the procedural vagueness [23] regarding the SEA hinder a comprehensive analysis of the SEA system in Brazil. The Brazilian experience is quite limited, with about 40 known cases [21]. Nevertheless, empirical research focused on

SEA practice has been found elsewhere: 24 SEA cases [31]; 35 cases until 2014 [25]; and 32 SEA cases [32].

In this paper the sample considered SEA reports that: a) were issued before and after the launching of the NPCC; b) covered distinct types of planning with effects on climate change directly or indirectly; c) came from different regions of Brazil.

The data set comprises 35 SEA reports carried out between 1997 and 2014, which were categorized into different types of planning categories [33]: energy planning – 11; regional development planning – 8; transport planning – 10 and tourism planning – 6, presented in Table 1.

3.1. A framework to analyze integrating climate change into the SEA reports

A recent debate regarding the use of the SEA in Brazil reinforced the need of developing a national SEA procedural framework considering the international experience [19,21,31]. Therefore, this paper is based on the best available international practices to assess climate change in SEA [34].

To explore the Brazilian experience in climate change concerning SEA-supported planning, a framework [12] previously tested in a representative sample of SEA reports from England and Germany was chosen, thus enabling the assessment of the extent to which SEA reports include aspects of climate change. The authors [12] developed review criteria based on guidelines for conducting SEA by incorporating the impacts of climate change, especially from the Organization for Economic Co-operation and Development (OECD), Canadian Environmental Assessment Agency, England and Wales Environment Agency and the UK Departament for Communities and Local Government. The primary purpose of these criteria is to examine the compliance of procedures considering climate change issues in planning rather than delivering a substantive analysis of the contents regarding this issue in the set of SEA reports. The framework [12] has 15 climate change issues, split into 29 categories of analysis (Table 2).

3.2. Exploring the Brazilian practice in climate change within SEA reports

The criteria presented in Table 2 were applied to 35 Brazilian SEA reports selected as the dataset. The first step was to define the keywords representing climate change issues. In order to proceed with the content analysis according to [36], the words/expressions related to climate change presented in Table 2 were used as keywords; other keywords were derived from the literature [15,35]. In this sense, the following keywords were used: adaptation, change, warming, greenhouse gases, emissions, air emissions, greenhouse gas emission, indicator, particulate matter, goal, mitigation, climate, air quality, National Policy on Climate Change and Climate Change Policy.

These keywords were applied to the content of the SEA reports, to identify the references to CC issues and to establish the context (e.g., accompanying arguments, facts, ideas, connections) involving climate change aspects. In a subsequent stage, the central idea of each reference to CC issues was identified by a content analysis following the procedures described by [36] and using the criteria presented in Table 2, thus enabling a systematic arrangement of the core information. This procedure was repeated to encompass all the 29 criteria.

The quality review was carried out examining three possibilities: i) the best grade: climate change issues are fully considered; ii) the intermediate grade: climate change issues are slightly or indirectly considered; iii) the worst grade: climate change issues are not considered, or there was no information related to the criterion.

Finally, there was a discussion on results concerning the integration of climate change issues in the Brazilian SEA practice and the likely influence of the Brazilian climate change policies on the approach to climate change adopted in the strategic planning guided by the SEA.

In order to check whether there is an evident influence of the NPCC on the integration of climate change issues into the Brazilian plans and programs supported by the SEA, we took into account the 35 SEA reports analyzed (14 of which were prepared after the NPCC entered into force). Assuming that the NPCC may have an influence on the development of policies, plans and programs in Brazil, it is reasonable to expect that climate change would appear as a relevant aspect within the SEA reports.

Thus, the following principles and objectives established by the NPCC were considered as likely driving forces to consider CC issues: i) the adoption of measures to prevent, to avoid or to minimize the causes of climate change identified in the Brazilian territory; ii) the reduction of anthropogenic GHG emissions and the intensification of carbon removals; iii) the use of integrated strategies to promote mitigation and adaptation to climate change at local, regional and national levels.

4. Results and discussion

Table 3 presents the results from the evaluation of 35 SEA reports from different sectors – energy, regional development, transportation and tourism – in Brazil.

By analyzing Table 3, considering climate change integration into SEA reports, the outcomes reveal that:

- climate change (CC) was mentioned in 22 out of the 35 SEA reports; this means the remaining 13 reports have no mention of climate change aspects;
- considering the different planning sectors, CC issues were addressed in 6 (out of 11) reports on energy; in 5 (out of 8) reports on regional development; in 8 (out of 10) SEA reports on the transportation sector; and in 3 (out of 6) reports on tourism;
- the best individual performance of SEA report was found in the energy sector (energy – SEA report 11), scoring for 11 criteria (out of 29), including 9 criteria classified in the intermediate grade (CC issues were only partially addressed);
- considering the transportation sector, the best SEA report scored in 9 (out of 29) criteria (transportation – SEA report 8); in the regional development sector, the best report scored in 7 criteria (5 of them scoring as the best grade) (regional development – SEA report 8); 3 other SEA reports of the energy sector scored reasonably with 7 (energy – SEA report 1; energy – SEA report 10) and 6 criteria (energy – SEA report 8).

Despite the poor general performance of the SEA reports, evidences of best practice were found more frequently after the NPCC (see grey columns in Table 3). In fact, there is a significant increase in the number of criteria that were partially or adequately addressed in the SEA reports after the NPCC was enforced: whilst 6% (36 out of 609) of the quality review criteria scored the intermediate and the best grade in the SEA reports prepared before the NPCC, this number jumped to 14.5% (59 out of 406) after the NPCC. The outcomes also indicate the following:

- although the best performance was generally found in the SEA reports prepared after the NPCC, 4 reports from that period did not mention CC at all (energy – SEA report 10; tourism – SEA reports 2, 3 and 4);
- there is virtually no explicit mention to any kind of CC policy (be it National, State or local) — this was found only in a single SEA report prepared after the NPCC (in this case, from the transportation sector).

Regarding the frequency of each individual criterion (described in Table 2) considering the 29 criteria presented in Table 3, the outcomes show that:

- 5 out of 29 criteria were absent from the SEA reports with regard to CC issues (criterion 7 – methods for regionalization; criterion 16 - climate change target; criterion 17 – alternatives related to CC

Table 1
Brazilian SEA reports characterization.

Strategic Environmental Assessment Reports – Brazilian States	Year	Categories
1. Brazil-Bolívia Gas Pipeline (Mato Grosso do Sul, São Paulo, Paraná, Santa Catarina, Rio Grande do Sul)	1997	Energy
2. Chopim river basin, (Paraná)	2002	
3 Areia river basin (Paraná)	2002	
4. Oil & Natural Gas Sector (Bahia)	2003	
5. Northwest of Minas Gerais Rural Electrification Program (Minas Gerais)	2005	
6. Verde river basin (Mato Grosso do Sul)	2007	
7. Minas Gerais hydropower generation program (Minas Gerais)	2007	
8. Petrobras Investment Program in Guanabara Bay (Rio de Janeiro)	2009	
9 Turvo river basin (São Paulo)	2009	
10. Planning of the Port, Industrial, Naval Offshore Dimension in the São Paulo Coast (São Paulo)	2010	
11. Expansion Plans of Eucalyptus Forestry and Biofuel in the Extreme South of Bahia (Bahia)	2011	
1. Portfolio of National Axes - Ministry of Planning (many states of Brazil)	2003	Regional Development
2. Social and Environmental Program of the Manaus Igarapes (Amazonas)	2004	
3. Sustainable Development Program for the Sergipe Semi-Arid (Sergipe)	2005	
4. Program for Improvement of the Urban Environmental Quality of Amapá (Amapá)	2006	
5. Alto Paraguai river basin development (Mato Grosso e Mato Grosso dos Sul)	2008	
6. Corumbá Mining-Industrial Pole and Influences on the Pantanal Plain (Mato Grosso do Sul)	2008	
7. Development Industrial Plan for Espírito Santo (Espírito Santo)	2008	
8. Conservation and Sustainable Management Planning for the Caatinga Biome (Ceará)	2010	
1. Transportation Program by IDB II, 1st phase (Paraná)	2002	Transportation
2. Roaring Program Mário Covas (São Paulo)	2004	
3. Accessibility Program for Small-Scale Municipalities with Low Human Development by IDB (Minas Gerais)	2005	
4. São Paulo Road Recovery Program (São Paulo)	2005	
5. Minas Gerais Road Program (Minas Gerais)	2007	
6. Integrated Brasilia Transport Program (Distrito Federal)	2007	
7. Açu Industrial and Port Complex (Rio de Janeiro)	2009	
8. Multimodal Transport and Mineral-Industrial Development Program of the Cacao Region (Bahia)	2010	
9. Metropolitan Arch of Rio de Janeiro (Rio de Janeiro)	2010	
10. Regional Integrated Development Plan for the Capricorn axis bioceanic corridor (some states)	2011	
1. North Coast Tourism Development Program (Ceará, Maranhão e Piauí)	2007	Tourism
2. Tourist Poles of the State of Rio de Janeiro (Litoral area) (Rio de Janeiro)	2011	
3. Tourist Poles of the State of Rio de Janeiro (Mountain area) (Rio de Janeiro)	2011	
4. Plan for the Integrated Development of Sustainable Tourism, (Rio Grande do Norte)	2011	
5. Regional Tourism Development Programs of Campo Grande area (Mato Grosso do Sul)	2014	
6. Regional Tourism Development Programs of Serra da Bodoquema area (Mato Grosso do Sul)	2014	

Note: the fields highlighted in grey refer to the SEA reports developed after the NPCC.

Table 2
Framework to evaluate the integration of climate change issues into the SEA reports [12]. Source: adapted from [12].

15 main climate change issues	29 categories of analysis	
Scoping	1	Mitigation
	2	Adaptation
	3	Opportunities
National goals	4	
State goals	5	
Regional Scale	6	Goals
	7	Methods for regionalization
Mitigation addressed	8	Avoidance
	9	Reduction
	10	Offsetting
Adaptation addressed	11	
Climate Change	12	General principles/strategies
	13	Objectives/goals
	14	Factors
	15	Indicators
	16	Target
Alternatives related to CC	17	Content related
	18	Spatial/Structural
CC aspects of sectoral planning contents	19	Transport
	20	Energy
	21	Housing
	22	Agriculture/Forestry
Monitoring	23	
Participation	24	
Cumulative effects	25	on climate change
	26	by climate change
Large scale impacts assessed	27	
Long-term impacts assessed	28	
"CC – biodiversity" – relationship addressed	29	

CC = climate change.

contents; criterion 18 – spatial/structural alternatives related to CC and criterion 28 – long-term impacts assessed);

- from the remaining 24 criteria, of the highest frequency of criteria are related to: mitigation (criterion 1 – 13 scores, all in the intermediate grade); mitigation addressed by reduction (criterion 9 – 12 scores; only 2 were classified as the best grade); and CC aspects of sectoral planning contents with regarding transportation (criterion 19 – 8 scores; only 1 was classified as the best grade);
- Note the criteria related to monitoring (criterion 23 – 6 scores; only 3 were classified as the best grade); cumulative effects by climate change (criterion 26 – 6 scores; only 2 were classified as the best grade); and with 5 scores in the intermediate grade criterion 13 (objectives/goals of CC; criterion 26 (CC aspects of sectoral planning contents regarding energy) and criterion 27 (large-scale impacts assessed).

These results are aligned with the literature. They show the limited current practice of SEA embracing climate change issues in a reductionist approach. They mainly focus on mitigation, instead of adaptation [30] and poorly explore the synergies between adaptation and other aspects for tackling climate change [27]. Another mismatch verified regards CC aspects of sectoral planning contents. The SEA studies emphasized transport and energy, the main global concerns, and neglect local problems, notably related to land use, agriculture and cattle activities [2].

Within this generally poor performance scenario, some evidences of best practice can be found in different cases:

- Energy – SEA report 11 (Expansion Plans for Eucalyptus Forestry and Biofuel in Southernmost Bahia): the political context involves the consolidation of '*flex-fuel technology in automobiles and the concern with climate change, eventually leading governments to adopt measures to mitigate GEE emissions*' [37, pg. 76]. The use of biofuels was assumed to be part of the strategies to mitigate CC; besides, SEA also considered mitigation and adaptation measures for biodiversity conservation, linked to the state program for GHG reduction. The recommendations included increasing the extension of protected areas by using the current knowledge related to the effects of CC on the local flora and fauna; to recover native vegetation by forming ecological corridors; to stimulate/facilitate the insertion of small farmers into the forest products market by better organization and capacity building [37]. The consolidation of a low carbon economy in agriculture would allow an increase in income generation, considering a new demand by the following activities: land/pasture remediation; no-till farming; development of hybrid systems to integrate forest-cattle-crops; replacement of nitrogen fertilizers prioritizing the biological cycle; development of forests to be explored [37];
- Transportation – SEA report 8 (Açu Industrial and Port Complex): the effects related to GHG emissions should be minimized and compensated by implementing environmental control and protection mechanisms. Amongst the policies formulated to address CC issues, the Rio Energia program stimulates the use of natural gas as a major source of fuel by the industrial plants to be installed in the region; the adoption of the best available technology to control GHG emissions in industrial sources; self-monitoring of air polluting parameters by transportation (cargo and passengers) companies; the adoption of mechanisms to compensate GHG emissions, as part of a wider policy to decrease carbon emission; support to biofuel production; forest recovery programs [38].
- Regional development – SEA report 8 (Conservation and Sustainable Management Planning for the Caatinga Biome, Ceará): the effects of climate change and its impacts on the biodiversity were considered a relevant variable to assess the alternatives in this SEA report. I it recognizes the need for addressing local vulnerabilities, defining objectives/priorities and developing integrated plans/policies, as the main aspect to be considered to secure the best alternative strategic scenario for the Caatinga biome (a world-class hotspot). One basic aspect of the Caatinga development relates to adapting to climate change, given the fact that the likely scenarios indicate a massive transformation in the migratory patterns and access to natural resources. Therefore, the SEA recommendations included a strategic approach based on the formulation of tiers of planning, focused on the needs of the local environment and community; strengthening state and municipal institutional capability; the implementation of Agenda 21 by local governments; increasing the effectiveness of monitoring and control of environmental impacts on the Caatinga; increasing knowledge distribution and access to information [39].

The case of the Energy – SEA report 11, which performed better amongst all the other cases studied herein, was also analyzed by [40]. According to the authors, the approach adopted in this SEA focused the integration of environmental concerns into both sectoral and territorial planning, considering the opportunities derived from biofuel production and forestry. These aspects presumably influenced the wider scope of CC issues as compared to the other SEA reports analyzed herein, thus signaling the relevance of the SEA objectives to ensure adequate room to include relevant issues in the assessments.

The outcomes obtained in the Brazilian context can generally be compared to what was reported by a research analyzing the CC issues of SEA in England and in Germany [12]. Specifically, and similarly to Brazil, a number of cases were verified in Germany that have not scored in any review criteria (2 out of 6 SEA reports), although others have systematically performed better than their equivalent in Brazil, and the best performance showed to be far superior (16 out of 29 criteria with a positive score).

Considering the same research [12], the picture is quite distinct in the English context. CC issues were clearly addressed in all of the 6 reports reviewed, which have scored positively in 15 criteria in the

Table 3
Results of the evaluation of climate change issues in the Brazilian SEA reports.
Source: adapted from [12].

criteria	SEA reports																																	
	energy											regional development								transportation										tourism					
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6
1	x				x								x		x					x		x			x	x	x	x	x					x	x
2																			x																
3											x																x								
4	x																																		
5										x																	x								
6							y																y												
7																																			
8																																		y	y
9	x						x			x					x					x		x			x	x	x		y				y	y
10								x			x																x								
11											y								y																
12					x		x				x																x								
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19	x							x		x	x									x				x	y		x							
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23	x							x									y		y						y			x						
24																				y															
25										x						x			y							x			y						
26											x					x			y							x			y	x					
27	x																x		x														x	x
28																																			
29											y								y																

Note: Grey cells indicate the criteria explicitly linked to the NPCC principles/objectives and the SEA reports prepared after the NPCC.

CC = climate change.
' y ' – the best grade: CC aspects and issues are explicitly addressed;'
'x' – the intermediate grade: CC aspects are slightly or indirectly addressed.
' ' (empty) – the worst grade: CC aspects are not considered or there is no information about them.

worst case (far superior to the best performance in Brazil and virtually the same performance of the best case in Germany) and to 21 criteria (out of 29) in the best case. In England and in the UK in general, the good performance of SEA in terms of addressing CC issues was also revealed by [34], for a sample of 36 SEA reports [41], specifically considering SEA applied to solid waste local plans.

Sixty percent of the SEA reports (87 out of 151 reports reviewed) applied to the different levels (sectoral, regional, local) in Denmark, included CC issues [26]. The main drawback, however, was related to the lack of an explicit and effective approach to capture the uncertainties inherent to this subject. Besides, other work [6] reported that the development of alternatives and/or strategies to adapt to CC was not a major objective of the SEA in that country. In the case of Brazil, apart from the already mentioned examples of best practice found in our research, the picture points to a similar situation: the current practice of SEA in Brazil has not considered adapting to CC scenarios.

The outcomes reinforce what was previously reported in the literature, regarding the gap between the SEA theory and practice [7], confirmed in different opportunities. A number of SEA reports prepared for the Tourism sector were reviewed [42] and, based on the poor performance as compared to other sectors, such as transportation and spatial planning, it was considered to be at the early stages of development and maturity. Similarly, our findings revealed the same picture in the case of Brazil. They are in line with other Brazilian researches that evaluated the general quality of the SEA reports for the transportation sector [23,24], for renewable energy [25] and diversified contexts [31].

The legal context in the EU establishes that member states have to accomplish the Kyoto targets of reducing GHG emissions [30], as well as making the SEA a mandatory instrument for certain plans and programs [7], which is quite the opposite from the Brazilian context, where both SEA [19] and the Kyoto targets are voluntary [4]. The existence of a clearly structured framework to support a systematic use of the SEA and its integration to plan making has been pointed out as a characteristic of the SEA systems. This could be strongly related to good SEA practice [43,44], which would lead to better SEA reports. Apparently, the lack of a mandatory use of SEA in Brazil is a key aspect to understand the poor performance verified and largely reported in the literature [21,23,25,31,45].

5. Conclusions

The integration of CC issues into the SEA-supported sectoral planning/regional development in Brazil can be considered limited and disappointing. The analysis of the 35 SEA reports – almost the totality of the SEA reports prepared in the country – of diversified sectors of Brazilian development reveals that the integration of CC issues within planning – one of the main challenges of good SEA practice – is far from being considered adequate.

Regarding the presence of CC issues in planning guided by SEA and considering the different sectors, the transportation sector stood out with the major frequency of SEA reports (8 out of 10) that embraced these aspects; and the energy sector achieved the best individual results for the set of SEA reports analyzed (11 out of 29).

The best result of each SEA report analyzed by the set of criteria (11 out of 29) reached merely 37% of the possible score of framework criteria. Considering the presence of each individual criterion within the SEA reports, just one criterion appeared 13 times in the set of the SEA reports (35) thus the best result only represented 37% of the possible frequency of the criteria In both analysis the quality of the CC issue was not even considered because the great majority of the associations were classified as intermediate grade. This illustrates the unsatisfactory approach to CC issues in planning guided by SEA in Brazil.

Although 14 out of 29 SEA reports (40% of the sample) were prepared after the enactment of the main national law on climate change, the influence of the NPCC on tiering sectoral and regional planning can be considered weak. From these 14 SEA reports, 5 SEA reports do not mention CC issues; 4 SEA reports have achieved intermediate scores; 5 have achieved the best scores compared with the set of SEA reports; and no mention to CC policy was not found in these 14 SEA reports.

The Brazilian SEA practice barely considers CC issues and this reflects in a concerning low number of recommendations regarding tiering planning related to the principles and objectives established by the NPCC — even when this concerns mitigation measures, a basic aspect to be considered, but also related to adaptation as well. In fact, there were practically no results for adaptation in the set of SEA reports (only 1 mention of adaptation scoping and 2 mentions adaptation were addressed). Moreover, SEA reports have not presented alternatives to CC issues or to integrating long-term impacts.

There is a long way to be followed to ensure the promotion of CC aspects in policies, plans and programs supported by the SEA in Brazil. In this sense, the evidence presented here reinforces what was previously concluded by other researches [19,21,25] regarding the need of a legal framework to define clear objectives and procedures for the SEA practice in the country, thus allowing to explore its potential to promote the integration of NPCC objectives into plan-making.

The SEA in Brazil has shown severe limitations as regards including climate change as a major aspect to be considered but, in general, this picture follows the international context as reported in the literature. Nonetheless, some evidences of international best practice were found, demonstrating the importance of SEA contributions to plan making. In this sense, it is believed that the lessons learned from the Brazilian context can be used to inspire other countries to strengthen the SEA capacity to influence strategic decisions and, therefore, to contribute to the effectiveness of climate change public policies.

Finally, we assume that the main missing link between climate change policy and sectoral/regional planning is related to the weak influence of the NPCC in the planning formulation, clearly resulting in the lack of legal enforcement and guidelines for using the SEA in the country. This assumption is confirmed by at least one relevant piece of evidence. Although the State of São Paulo policy has explicit provisions for applying the SEA in planning developments, the SEA reports from the state after the NPCC (Energy – SEA report 9, Energy SEA report 10 and Transportation – SEA report 10) show the complete absence to the limited consideration of CC issues in their contents and neither this state policy nor the federal one have been mentioned in any studies.

This may even be a paradox; despite the existence of a law that clearly advocates the use of SEA for planning, undertaking the SEA in the country is voluntary. In order to improve the inclusion of CC in the SEA practice in Brazil, the formal and legal implementation of the SEA in the country has to be considered. This recommendation is aligned with a recent study [46] discussing why the SEA has not advanced in Brazil, highlighting the need for prioritizing the SEA application to public policies, which is exactly the case advocated here.

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